REMARKS

Claims 1, 9, 11 and 18 have been amended. No new matter has been introduced. Claim 3 has been canceled and its subject matter has been incorporated in amended independent claim 1. Claims 1, 2 and 4-20 are pending in this application.

Claims 1, 2, 5, 9, 11-17 and 19 are rejected under 35 U.S.C. § 102 as being anticipated by Okuyama et al. (U.S. Patent No. 5,740,193) ("Okuyama"). The rejection is respectfully traversed and reconsideration is respectfully requested.

The claimed invention relates to an optical device and method of introducing recombination centers in a tuning region of the optical device. As such, amended independent claim 1 recites a "tuning region of a semiconductor optical device" comprising *inter alia* "a first cladding layer" and "a waveguide layer provided over . . . said first cladding layer, at least a portion of said device having a concentration of recombination centers in the range of about $1x10^{16}$ cm^{-3} to about $1x10^{18}$ cm^{-3}." Amended independent claim 1 also recites that the recombination centers "are formed by doping said at least a portion of said device with impurity atoms selected from the group consisting of iron, chromium, manganese and copper."

Amended independent claim 9 recites an "optoelectronic device comprising" *inter alia* "at least one tuning region; a first cladding layer; a waveguide layer of said at least one tuning region provided over at least a portion of said substrate and said cladding layer, said waveguide layer having a thickness of about 2,000 Angstroms, and at least 100 Angstroms of said waveguide layer having a concentration of recombination centers in the range of about $1x10^{16}$ cm^{-3} to about $1x10^{18}$ cm^{-3}." Amended independent claim 9 also recites "a second cladding layer, said first and second cladding layers forming a p-n junction around said waveguide layer, and electrical contacts to said first and second cladding layers."

Amended independent claim 11 recites a "method of introducing recombination centers in a tuning region of a semiconductor optical device" by *inter alia* "forming an

InGaAsP waveguide layer . . . under conditions selected to provide recombination centers" and "subjecting said device to said conditions selected to provide recombination centers."

Okuyama relates to a "II-VI group compound semiconductor light-emitting device" which can emit light of a short wavelength at room temperature. (Abstract). Okuyama teaches that "on a first conductivity type, e.g., n-type GaAs substrate 1, there is epitaxially grown a ZnSe buffer layer 5 on which there are epitaxially grown a first cladding layer 2 . . . made of ZnMgSSe doped by Cl as n-type impurity, a ZnSe active layer 3 . . . and a second cladding layer 4 . . . ZnMgSSSe doped by N (nitrogen)." (Col. 3, lines 62-67; Col. 4, lines 1-4). Okuyama further teaches a "first semiconductor layer 6 . . . made of ZnSSe doped by N" and "a second semiconductor layer 7 having a thickness of about 700 nm made of ZnSe" epitaxially grown on the second cladding layer 4. (Col. 4, lines 5-15).

Okuyama fails to disclose all limitations of independent claims 1, 9 and 11. Okuyama fails to teach or suggest a waveguide layer of an optical device having "a concentration of recombination centers in the range of about $1x10^{16}$ cm^{-3} to about $1x10^{18}$ cm^{-3}, wherein said recombination centers are formed by doping said at least a portion of said device with impurity atoms selected from the group consisting of iron, chromium, manganese and copper," as claim 1 recites. Okuyama teaches that active layer 3 is "made of ZnSe, for example, and doped by Cl," and does not have "a concentration of recombination centers . . . formed by doping said at least a portion of said device with impurity atoms selected from the group consisting of iron, chromium, manganese and copper," as in the claimed invention.

Okuyama also fails to disclose, teach or suggest "a waveguide layer . . . having a thickness of about 2,000 Angstroms, and at least 100 Angstroms of said waveguide layer having a concentration of recombination centers in the range of about $1x10^{16}$ cm^{-3} to about $1x10^{18}$ cm^{-3}," as claim 9 recites. Okuyama teaches that the ZnSe active layer 3, which would arguably correspond to the waveguide layer of the claimed invention, has "a thickness of about 70 nm" (col. 3, line 67; Col. 4, line 1), not "of about 2,000 Angstroms," as in the claimed invention. Okuyama also fails to disclose, teach or suggest

that "at least 100 Angstroms of said waveguide layer" has "a concentration of recombination centers in the range of about 1×10^{16} cm^{-3} to about 1×10^{18} cm^{-3}," as claim 9 recites.

Okuyama is also silent about all limitations of amended independent claim 11. Okuyama does not teach or suggest a "method of introducing recombination centers in a tuning region of a semiconductor optical device," much less a "method of introducing recombination centers in a tuning region of a semiconductor optical device" by "forming an InGaAsP waveguide layer . . . under conditions selected to provide recombination centers," as claim 11 recites. Instead, Okuyama teaches "a II-VI group compound semiconductor, e.g., semiconductor laser . . . formed on a GaAs substrate 1 by epitaxially growing a ZnMgSSe II-VI group compound semiconductor layer," and not a III-V group semiconductor layer such as InGaAsP waveguide layer of the claimed invention. Claims 2 and 5 depend from claim 1 and claims 12-17 depend from claim 11. For at least the reasons above, the subject matter of claims 1, 2, 5, 9, 11-17 and 19 is not anticipated by Okuyama, and withdrawal of the rejection of these claims is respectfully requested.

Claims 4, 6-8, 10, 18 and 20 are rejected under 35 U.S.C. § 103 as being unpatentable over Okuyama in view of Furuyama et al. (JP 60-65588) ("Furuyama"). The rejection is respectfully traversed and reconsideration is respectfully requested.

Furuyama relates to an "InGaAsP crystal layer 12 which has [a] different refraction index from that of an InP substrate 11." (Abstract). For this, Furuyama teaches that an "InGaAsP crystal is thermally deformed in a raised portion by the heat treatment in the atmosphere containing P to recrystallize the recess." (Abstract). Specifically, Furuyama teaches that "[t]he surface of the flattened sample is formed by alternately arranging two crystal layers of different refraction indexes, and a diffraction grating is formed by the variation in the periodic refraction index." (Abstract).

The subject matter of claims 4, 6-8, 10, 18 and 20 would not have been obvious over Okuyama in view of Furuyama. Indeed, the Office Action fails to establish a *prima*

facie case of obviousness. Courts have generally recognized that a showing of a *prima facie* case of obviousness necessitates three requirements: (i) some suggestion or motivation, either in the references themselves or in the knowledge of a person of ordinary skill in the art, to modify the reference or combine the reference teachings; (ii) a reasonable expectation of success; and (iii) the prior art references must teach or suggest all claim limitations. See e.g., In re Dembiczak, 175 F.3d 994 (Fed. Cir. 1999); In re Rouffet, 149 F.3d 1350, 1355 (Fed. Cir. 1998); Pro-Mold & Tool Co. v. Great Lakes Plastics, Inc., 75 F.3d 1568, 1573 (Fed. Cir. 1996).

In the present case, Okuyama and Furuyama, whether considered alone or in combination, fail to teach or suggest all limitations of claims 4, 6-8, 10, 18 and 20. Claims 4 and 6-8 depend from claim 1, claim 10 depends from claim 9 and claim 20 depends from claim 11. As noted above, Okuyama does not teach or suggest all limitations of claims 1, 9 and 11. Similarly, Furuyama is silent regarding a waveguide layer of an optical device having "a concentration of recombination centers in the range of about $1x10^{16}$ cm^{-3} to about $1x10^{18}$ cm^{-3}," as claims 1 and 9 recite. Furuyama is also silent about a "method of introducing recombination centers in a tuning region of a semiconductor optical device" by "forming an InGaAsP waveguide layer . . . under conditions selected to provide recombination centers" and "subjecting said device to said conditions selected to provide recombination centers," as claim 11 recites. Furuyama teaches an InGaAsP crystal which is "thermally deformed in a raised portion by the heat treatment in the atmosphere containing P to recrystallize the recess," not a waveguide layer of an optical device having recombination centers in a specific concentration range, as in the claimed invention.

In addition, a person of ordinary skill in the art would not have been motivated to combine the teachings of Furuyama with those of Okuyama, and to "modify Okuyama et al device to have an InP substrate and InGaAsP waveguide layer forming a DBR laser device," as the Office Action asserts. (Office Action at 4). The crux of Okuyama is the formation of "a II-VI group compound semiconductor" such as a ZnMgSSe II-VI group compound semiconductor layer. In contrast, Furuyama teaches an InGaAsP crystal (a III-

V group waveguide layer) which is "thermally deformed in a raised portion by the heat treatment in the atmosphere containing P to recrystallize the recess," and not a II-VI group waveguide layer, as disclosed in Okuyama. Accordingly, a person of ordinary skill in the art would not have been motivated to combine Okuyama, which teaches away from the use of a III-V group waveguide layer, with Furuyama, which teaches an InGaAsP crystal, that is a III-V group waveguide layer. For at least these reasons, the Office Action fails to establish a *prima facie* case of obviousness, and withdrawal of the rejection of claims 4, 6-8, 10, 18 and 20 is respectfully requested.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

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Respectfully submitted,

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